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CEIWR-HEC-HH 25 July 2002

Simulation Lake-Groundwater Interaction, South Lake Tahoe, California

Scope of Work

I. Background

On 12 July 2002, the Hydrologic Engineering Center (HEC) was contacted by the Sacramento District of the U.S. Army Corps of Engineers to provide technical assistance with an on-going environmental study at the southern Lake Tahoe Basin in California. Specifically, HEC was requested to review and apply a groundwater flow model developed by AGRA Earth & Environmental, Inc. (1999) to better understand lake-groundwater interaction.

II. Project Setting

The Lake Tahoe Basin lies near the crest of the Sierra Nevada Mountains along the California-Nevada border about 150 miles northeast of San Francisco. Lake Tahoe has a surface area of approx. 191 square miles. The total land area of the Tahoe Basin's watershed is approx. 300 square miles, 70% of which is publicly owned. The Tahoe Basin is essentially a closed hydrologic system i.e. the volume of inflow and outflow from the lake is very small relative to lake volume. This results in a fragile ecosystem in which the actions of man and nature are tightly linked.

Over the past 40 years, a sharp increase in development has occurred around the lake, especially in the southern basin. During this period, lake water quality decreased dramatically. The cause of this is due to increased algae growth in lake water as a result of increased nutrient and sediment deposition to the lake. In Lake Tahoe, algae productivity has been found to accelerate with the addition of phosphorous and nitrogen. Numerous studies have been conducted and remediation measures have been implemented to reduce the discharge of nutrients to the lake. Studies indicate that groundwater may play a significant role in this discharge.

III. Problem Statement

Water exchange between the lake and the adjacent groundwater at South Lake Tahoe is not well understood. A better understanding of the interaction will help aid future remediation efforts at a critical location within the Tahoe Basin.

IV. Objective

Estimate the volume and rate of lake-groundwater interaction in the South Lake Tahoe area at specified locations and times.

V. Approach

There will be six phases in this work effort: 1) review of the existing model; 2) additional data gathering and analysis; 3) refinement of conceptual model; 4) model recalibration; 5) model application; 6) documentation and presentation.

A. Review of Existing Model

The existing MODFLOW model developed by AGRA Earth & Environmental, Inc. (1999) will be fully reviewed. This will include analysis of the conceptual model, data files, boundary conditions, model assumptions, time steps, model calibration, and the accuracy of the numerical solution. The model will be run, and a precursory sensitivity analysis of lake-groundwater interactions will be performed.

B. Additional Data Gathering and Analysis

Data from relevant previous modeling studies and site investigations will be reviewed. Agencies which will be contacted include: the Lahontan Regional Water Quality Control Board, the University of California–Davis, the University of Nevada-Reno, and the U.S. Geological Survey. The most recent digital maps and water-level data will be integrated into the model study.

C. Refinement of Conceptual Model

Conceptual model development will focus on providing a better understanding of the water exchange between groundwater and surface water. Features that should be described by the conceptual model include:

- overall water budget ;
- lake-groundwater interaction;
- system stresses (precipitation, evapotranspiration , withdrawal wells, etc.);
- aquifer material properties and the relationship and extent of hydrogeologic units;
- potentiometric surfaces;
- dynamic relationships varying through time.

The Sacramento District will assist in providing refined depiction of site geology. Hydrologic properties should be described in a level of detail commensurate with the ability of the data to represent the system. A highly complex system requires more (and/or higher quality) data to provide for the same level of detail in representing a more homogeneous, simple system.

D. Model Recalibration

The new conceptualization of the hydrogeologic system will be integrated into the existing computer model. The model will be initially calibrated to steady-state initial conditions. Once an acceptable steady-state calibration is attained, the model will then be calibrated under transient conditions.

E. Model Application

The model will be used as a tool to estimate the water exchange between Lake Tahoe and the adjacent groundwater regime. This water exchange will be estimated at specified locations over defined periods of time. The model will be run over several years and include seasonal variations.

F. Model Documentation and Presentation

Model documentation will include graphs of water exchange (over time) at specific locations along the lake-groundwater interface. Results of this work effort will be presented to the Sacramento District and other interested parties.

VI. Tasks

Estimated labor requirements for project completion are as follows:

Review of Existing Model ..... 5 days

Data Gathering and Analysis ..... 8 days

Refinement of Conceptual Model ..... 5 days

Model Recalibration .....……. 10 days

Model Application …….....… 10 days

Documentation and Presentation .....… 5 days

Total Time …….. 43 days

VII. Milestones

Each task will be completed by the following dates:

Review of Existing Model ..... 15 October 2002

Data Gathering and Analysis ..... 15 November 2002

Refinement of Conceptual Model ..... 1 December 2002

Model Recalibration .....…….. 1 April 2003

Model Application …….....… 15 April 2003

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Documentation and Presentation .....…. 5 May 2003

VIII. Products

Deliverables include: documentation of model development, model simulations, model calibration, model results, and model data sets. This specifically includes graphs depicting lake-groundwater interaction at specified locations.

IX. Personnel

This work effort will completed by Jon Fenske of the Corps of Engineers, Hydrologic Engineering Center, Davis CA. Additional technical assistance on the South Lake Tahoe groundwater model will be provided by Chris Wessel of AGRA Earth & Environmental, Inc.

X. District-Provided Data

The Sacramento District will provide a refined conceptualization of site geology to HEC by 15 November 2002.

XI. Funding

Jon Fenske- 43 days salary/expenses	=	$22,000
travel/misc.	=	$1,000
Chris Wessel- 3 days technical assistance	=	$2,000
Total	=	$25,000

The total cost of this work effort will be $25,000.

XII. References

AGRA Earth & Environmental, Inc., 1999, Groundwater Modeling Study- Final Report for South Tahoe Public Utility District, South Lake Tahoe, California, 137 p.

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